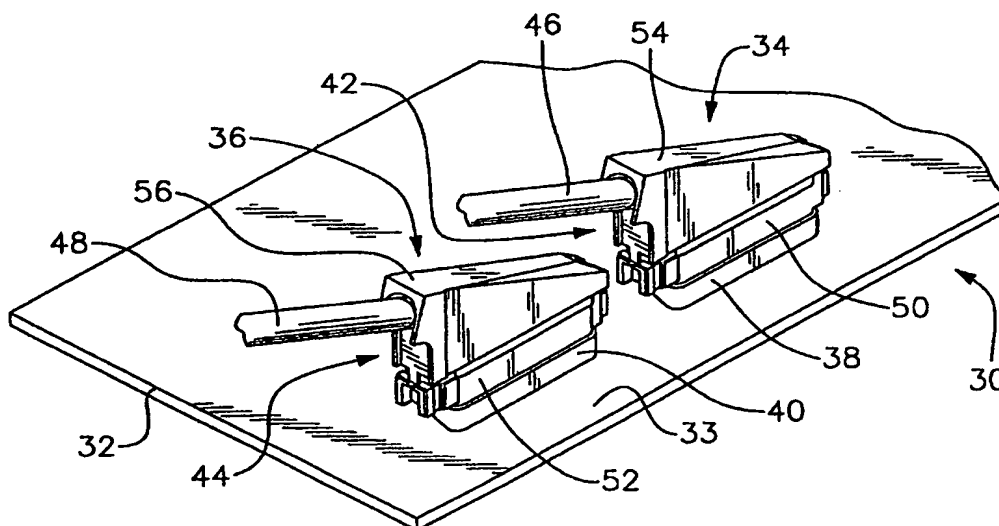




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>H01R 13/58</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 99/27616</b> <b>(43) International Publication Date:</b> 3 June 1999 (03.06.99)
<b>(21) International Application Number:</b> PCT/US98/24320 <b>(22) International Filing Date:</b> 13 November 1998 (13.11.98)  <b>(30) Priority Data:</b> 08/975,304      20 November 1997 (20.11.97)      US  <b>(71) Applicant:</b> SUPERIOR MODULAR PRODUCTS INCORPORATED [US/US]; 33 Superior Way, Swannanoa, NC 28778 (US).  <b>(72) Inventors:</b> BROWNELL, Kenneth, W.; P.O. Box 638, Marion, NC 28752 (US). SHRAM, John, G.; 108 Pink Fox Cove Road, Weaverville, NC 28787 (US).  <b>(74) Agents:</b> CARTER, David, M. et al.; Carter & Schnedler, P.A., Suite 103, 56 Central Avenue, P.O. Box 2985, Asheville, NC 28802 (US).		<b>(81) Designated States:</b> CA, DE, GB, MX, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** HIGH DENSITY ELECTRICAL CONNECTOR SYSTEM



**(57) Abstract**

There is provided a high density electrical connector system (30) including a panel for receiving a plurality of closely spaced elongated connectors (34, 36). Each connector (34, 36) includes two intermateable halves (38, 42). One of the connector halves (42) includes an elongated base (50) having wire termination members (68) on one side (80) and associated electrical contacts on the other side. A hood (54) covers the wire termination side (80) of the base (50). An electrical cable (46) containing a plurality of insulated wires (66) enters on the side (61) of the hood (54) adjacent to a closely spaced adjoining connector (36) at an angle greater than 0° but less than 90° with respect to the base (50) so that the cable (46) will clear the adjoining connector (36) without the need to unduly bend the cable (46). The top (64) of the hood (54) may be sloped downwardly from its cable receiving side (61) to the opposing side (62).

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High Density Electrical Connector SystemDescriptionTechnical Field

This invention relates to electrical connectors.

- 5 The invention more particularly relates to high density electrical connectors which are attached to panels where the connectors are closely spaced from one another.

Background Art

- A patch panel is used as an interface between  
10 common carrier telecommunication lines, a local area network hub, router, or data switch, and the end user equipment where the end user has a substantial number of lines to service telephones, work station computers, and other telecommunications and data communications equipment,  
15 such as modems and personal computers. Often a single patch panel will accommodate forty-eight separate lines. A patch panel, in general, consists of a printed circuit board, or a group of boards arranged end to end, having FCC RJ-45 jacks connected to one side and corresponding wire  
20 termination connectors attached the other side. The jacks connect the patch panel to the work station equipment through a patch cord and a second patch panel. The wire termination connectors connect the patch panel to the telephone equipment or computer equipment.

- 25 The terminated wires are often received in a twenty-five pair cable which is approximately 1 inch in diameter.

- There is a growing trend to utilize standard, twenty-five pair ribbon connectors on the telephone or  
30 computer side of the circuit board because of the ease of terminating the wires in the cable to the connector, and the space savings and cost savings associated with one cable rather than multiple, individual cables, and so that specific circuits may be easily removed from service, i.e.,  
35 the twenty-five pair connector is simply disconnected on

the board. A typical twenty-five pair connector is sold under the brand name AMP CHAMP. The architecture for the twenty-five pair connector interface has been standardized by the FCC and is referred to as the RJ-21X. In general, half of the connector body is permanently attached to the telephone company or computer side of the circuit board while the other half of the connector body terminates the twenty-five pair cable. In many cases, this structure is repeated at the telephone or computer equipment also.

In the case of a patch panel having twenty-four ports on the customer side, there are normally four ribbon connectors attached to the telephone company side. In some cases, a single circuit board is used, however, more often, four separate adjacent circuit boards are used, but are assembled together so that the boards are in the same plane and are contiguous with one another. The half of the standard ribbon connector which terminates the wire in the cable includes a hood having an opening at one end which receives the cable. Because of this configuration, the cable exits the connector parallel to the circuit board. Due to space and architecture requirements, the connector halves which are attached to the circuit boards are arranged end-to-end in rows and are closely spaced to one another, i.e., often less than 1½ inches apart. With the cable exiting from the other half of the connector parallel to the circuit board, the cable must be severely bent near the exit from the connector hood, otherwise the connector halves cannot be intermated. This problem is illustrated in Figure 1, which shows circuit board 10 having ribbon type connector halves 12 and 14 attached to the board while the other connector halves 16 and 18 terminate cables 20 and 22. As can be seen, cables 20 and 22 exit the connectors 16 and 18 at one end of their respective hoods 24 and 26 parallel to circuit board 10 resulting in bend 28 in cable 20. If the particular patch panel is a forty-eight port patch panel, there will be two additional ribbon connectors in line with

the ribbon connectors shown in Figure 1 so that two more cables will have to be bent. Bending a cable which carries high speed data, e.g., 100 MHz, will often degrade the signal transmission characteristics. On electronic  
5 equipment, this problem is even greater due to higher circuit density allowed by today's micro electronics. Connector spacing limits circuit density.

#### Disclosure of Invention

In accordance with one form of this invention,  
10 there is provided an electrical connector including a base. The connector base including a plurality of wire termination contacts. The connector includes a hood. The hood covers the base forming an enclosure with the base. The hood has an opening therein for receiving an electrical  
15 cable having a plurality of wires. A mechanism is provided to guide the cable into the hood and to hold the cable, where it enters the hood, at an angle greater than 0° but less than 90° with respect to the base. The hood includes a top and first and second ends. In one embodiment, the  
20 top slopes downwardly from the first end to the second end and the opening for receiving the cable is in the first end near the top.

In accordance with another form of this invention, there is provided an elongated twenty-five pair  
25 type connector having a wire termination side and a contact side. A hood covers the wire termination side of the connector. A cable containing insulated conductors is provided. The cable enters the hood at an angle greater than 0° but less than 90° with respect to the wire  
30 termination side of the connector.

In accordance with another form of this invention, there is provided a high density connector apparatus including a substrate which, preferably, is in the form of a circuit board. First and second electrical  
35 connectors are provided. Each connector includes first and second intermateable halves. The first halves are

connected to the circuit board. The first halves are closely spaced, preferably less than  $1\frac{1}{2}$  inches apart, and arranged end to end on the substrate. The second half of the first connector has a first base and a first hood and the second half of the second connector has a second base and a second hood. Each hood forms a part of an enclosure. Each hood has a first and second end. The first end of the first hood is adjacent to the second end of the second hood. The first hood has a top. A mechanism is provided to guide a cable into the first hood and to hold the cable, where it enters the hood, at an angle greater than  $0^\circ$  but less than  $90^\circ$  with respect to the first base. Preferably, the top of the first hood slopes downwardly from its first end to its second end. In one embodiment, the first hood has an opening in its first end near its top for receiving the cable which extends into the enclosure, thereby forming a mechanism for guiding and holding the cable. Because of the downward slope of the top of the hood and the position of the opening, the second connector does not interfere with the cable when the second half of the first connector is intermated with the first half.

In accordance with another form of this invention, there is provided a hood for an electrical connector having an elongated contact carrying base. The hood includes first and second sides, first and second ends, and a top and an open bottom. The bottom is adapted to be connected to the base. The hood and the base form an enclosure. The hood has an opening therein which serves to guide the cable, allowing the cable to exit the hood at an angle greater than  $0^\circ$  but less than  $90^\circ$  with respect to the connector body.

The invention thus provides an improved high density electrical connector.

The invention also provides an improved high density multiple connector patch panel, wherein each connector may be intermated without obstruction by its adjacent connector.

In addition the invention provides an elongated telecommunication connector, having a cable extending therefrom, which is used adjacent to another connector on a circuit board, whereby the cable need not be bent to avoid  
5 contact with the adjacent connector.

Furthermore, the invention provides an electrical telecommunication connector system for use with circuit boards, whereby the circuit density on the board is improved without degrading signal transmission  
10 characteristics.

#### Brief Description of the Drawings

The subject matter which is regarded as the invention is set forth in the appended claims. The invention itself, however, together with further objects  
15 and advantages thereof may be better understood in reference to the accompanying drawings in which:

FIGURE 1 is a pictorial view of a prior art electrical connector system;

FIGURE 2 is a pictorial view of the connector  
20 system of the present invention;

FIGURE 3 is a side elevational view of one of the connectors of Figure 2 having portions of the hood removed for illustrative purposes;

FIGURE 4 is a pictorial view of the connector of  
25 Figure 3, but with the entire hood removed for illustrative purposes;

FIGURE 5 is a pictorial view of the hood of the present invention; and

FIGURE 6 is a front elevational view of the  
30 connector of Figure 4.

#### Best Mode for Carrying Out the Invention

Referring now more particularly to Figure 2, there is provided high density connector apparatus 30 including substrate 32 which, preferably, is in the form of  
35 a printed circuit board. When used herein, the term

"substrate" or "printed circuit board" may mean a single substrate or single circuit board, or may also mean a plurality of substrates or circuit boards which are situated in a side by side co-planar arrangement.

5           The invention may be used with a patch panel, as described below. However, the invention is not limited to use with a patch panel. The invention may be used with other electrical equipment, such as computer equipment serving local area networks where high circuit density is  
10   important.

          The apparatus 30 of Figure 2 shows a portion of a patch panel having a plurality of telecommunication jacks attached to the front side (not shown) of circuit board 32. Figure 2 shows the back side 33 of the circuit board. As  
15   previously stated, the front side of a patch panel board is connected to the end user's telecommunication or computer equipment while the back side is normally connected to the telephone or computer lines. The subject invention relates to the interconnections on the back side 33 of the circuit  
20   board.

          Figure 2 shows ribbon connectors 34 and 36, including first connector halves 38 and 40, which are arranged in a closely spaced end to end arrangement and are attached to the back side 33 of circuit board 32. Second  
25   connector halves 42 and 44 are used to terminate the twenty-five pair cables 46 and 48. Second connector halves 42 and 44 include connector bases 50 and 52 which intermate with first connector halves 38 and 40. Screws, nuts and other latching mechanisms (not shown) may be used  
30   to hold the first connector halves to the second connector halves. Angled hoods 54 and 56 are received over bases 50 and 52, and the hoods include openings at one end thereof for receiving cables 46 and 48.

          In the preferred embodiment, connectors 34 and 36  
35   are identical. Therefore, the discussion of the construction of these connectors will be primarily limited to connector 36.



As can be better seen in reference to Figure 3, hood 54 forms a cavity 58 with base 50. Cable 46 extends into cavity 58 through opening 60 in the first end 61 of hood 54 near the hood top 64. Hood 54 also includes a  
5 second end 62. End 61 is higher than end 62 so that top 64 slopes downwardly from end 61 to end 62. A plurality of insulated conductors 66 extend from cable 46 into cavity 58 and are terminated by conductor termination members 68, shown in Figure 4, which are received in base 50.

10 Stud 70 extends from base 50 and receives a first clamp 72 of apparatus 74 which, along with opening 60, serves to guide and hold cable 46. Apparatus 74 includes a plate 76 and a second clamp 78 which is attached to cable 46. Apparatus 74 provides strain relief for the  
15 cable and, along with opening 60, also holds and guides cable 46 into cavity 58 and holds cable 46 at an angle greater than  $0^\circ$  but less than  $90^\circ$  with respect to the plane of circuit board 32, as well as with respect to the plane formed by the top surface 80 of base 50. In the preferred  
20 embodiment, the angle is approximately  $15^\circ$ .

As can be seen from Figure 5, opening 60 of hood 54 includes a rounded lip 82 to accommodate the round cable 46. Hood 54 also includes side walls 84 and 86 which form the remainder of enclosure or cavity 58. The  
25 bottom 88 of hood 54 is open for receiving the top surface 80 of base 50. Plate 76, which is shown in Figures 4 and 6, is located below opening 60 and forms the bottom edge of opening 60 and is useful in preventing foreign matter from penetrating into cavity 58.

30 This invention enables one to mate the first half 38 of the ribbon connector 34 with its second half 42 without the need to bend the cable 46, i.e., adjacent ribbon connector 36 will not interfere with the cable because of the angled exit of the cable from the hood 54.  
35 In addition, because of this design, the first halves 38 and 40 of the connectors 34 and 36 may be spaced closer, thereby enabling higher density circuit paths on the

circuit board and thus a smaller board, and in addition, the connector itself may be shortened.

From the foregoing description of the preferred embodiment of the invention, it will be apparent that many  
5 modifications may be made therein. It will be understood, however, that this embodiment of the invention in an exemplification of the invention only and that the invention is not limited thereto. It is to be understood  
10 therefore that it is intended in the appended claims to cover all modifications as fall within the true spirit and scope of the invention.

#### Industrial Applicability

The way in which the invention is capable of being exploited and the way in which it can be made and  
15 used will be apparent from the foregoing.

Claims

1. An electrical connector comprising:  
a base;  
a plurality of contacts attached to said base;  
5 a hood; said hood covering said base and forming  
an enclosure with said base; said contacts having wire  
termination portions; said hood receiving an electrical  
cable having a plurality of wires;  
a mechanism for guiding the cable into the hood  
10 and for holding the cable, where it enters the hood, at an  
angle greater than  $0^\circ$  but less than  $90^\circ$  with respect to  
said base.
2. A connector as set forth in Claim 1, wherein  
the hood has first and second ends and a top; said  
15 mechanism for guiding and holding includes an opening in  
said first end near said top; the cable extends out of the  
opening at an angle with respect to said base greater than  
 $0^\circ$  but less than  $90^\circ$ .
3. A connector as set forth in Claim 2, wherein  
20 said top slopes downwardly from said first end and said  
second end.
4. A connector as set forth in Claim 3, wherein  
said mechanism for guiding and holding further includes a  
support apparatus near said first end of said hood; one end  
25 of said support apparatus connected to said base and the  
other end of the support apparatus connected to the cable.
5. A connector as set forth in Claim 4, wherein  
said support apparatus also provides strain relief for the  
cable.
- 30 6. A connector as set forth in Claim 1, wherein  
said wires are terminated inside said enclosure.

7. A connector as set forth in Claim 1, wherein said connector is a ribbon connector.

8. A high density connector apparatus comprising:

- 5           a substrate;  
          first and second electrical connectors;  
          each connector having an elongated first half and  
          an elongated second half; each of said half having a base;  
          each first half connected to said substrate; said  
10 first halves being closely spaced and arranged end to end  
          on said substrate;  
          said second half of said first connector having a  
          first hood and said second half of said second connector  
          having a second hood;  
15           each hood forming an enclosure with its  
          corresponding base;  
          a mechanism for guiding a cable into said first  
          hood and for holding the cable, where it enters said hood,  
          at an angle greater than 0° but less than 90° with respect  
20 to its base.

9. A connector as set forth in Claim 8, wherein  
each hood has first and second ends; said first end of said  
first hood being adjacent to said second end of said second  
hood; said first hood having a top; said top being sloped  
25 downwardly from said first end to said second end; each  
hood having an opening in its first end for receiving a  
cable.

10. A connector as set forth in Claim 9, wherein  
said opening is near said top of said hood.

- 30           11. A connector as set forth in Claim 10,  
          further including a support apparatus near said first end  
          of said hood; one end of said support apparatus connected

to said base and the other end of the support apparatus connected to the cable.

12. A connector as set forth in Claim 8, wherein said cable has a plurality of conductors; said conductors  
5 terminated inside of said enclosure formed by said hood and said base.

13. A connector as set forth in Claim 8, wherein each connector is a ribbon type connector.

14. A connector as set forth in Claim 13,  
10 further including a strain relief member connected to the base and to the cable.

15. A hood for an electrical connector having an elongated contact carrying base comprising:  
an elongated member; said elongated member  
15 including first and second sides, first and second ends, a top and a bottom; said bottom being opened; said bottom adapted to be connected to the base; said elongated member and the base forming an enclosure; said elongated member having an opening therein for guiding a cable into said  
20 enclosure so that the cable, when it enters said opening, is at an angle greater than 0° but less than 90° with respect to said base.

16. A hood as set forth in Claim 15, wherein the opening is in said first end and is located near said top;  
25 said top sloping downwardly from said first end to said second end.

17. An elongated twenty-five pair type connector assembly comprising:  
a connector half including a base having a wire  
30 termination side forming a top surface;

a hood covering said wire termination side of said base;

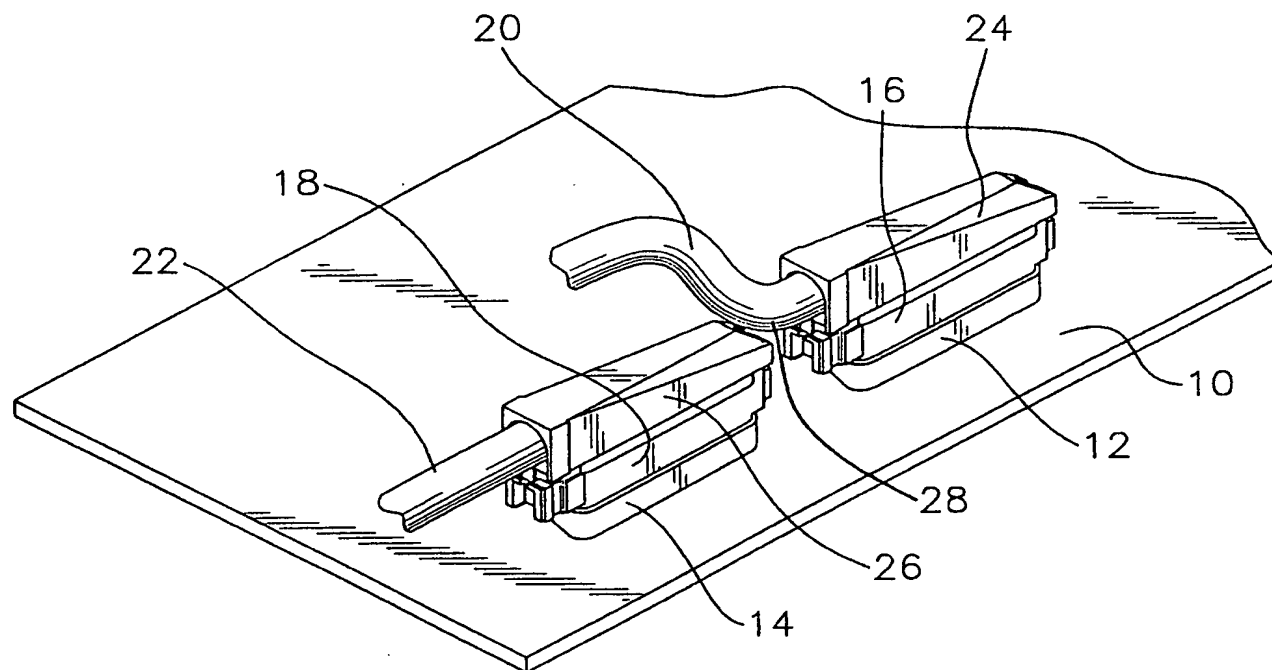
a cable having a plurality of insulated conductors;

- 5 an opening in said hood for receiving said cable; said cable being at an angle greater than  $0^\circ$  but less than  $90^\circ$  with respect to said top surface.

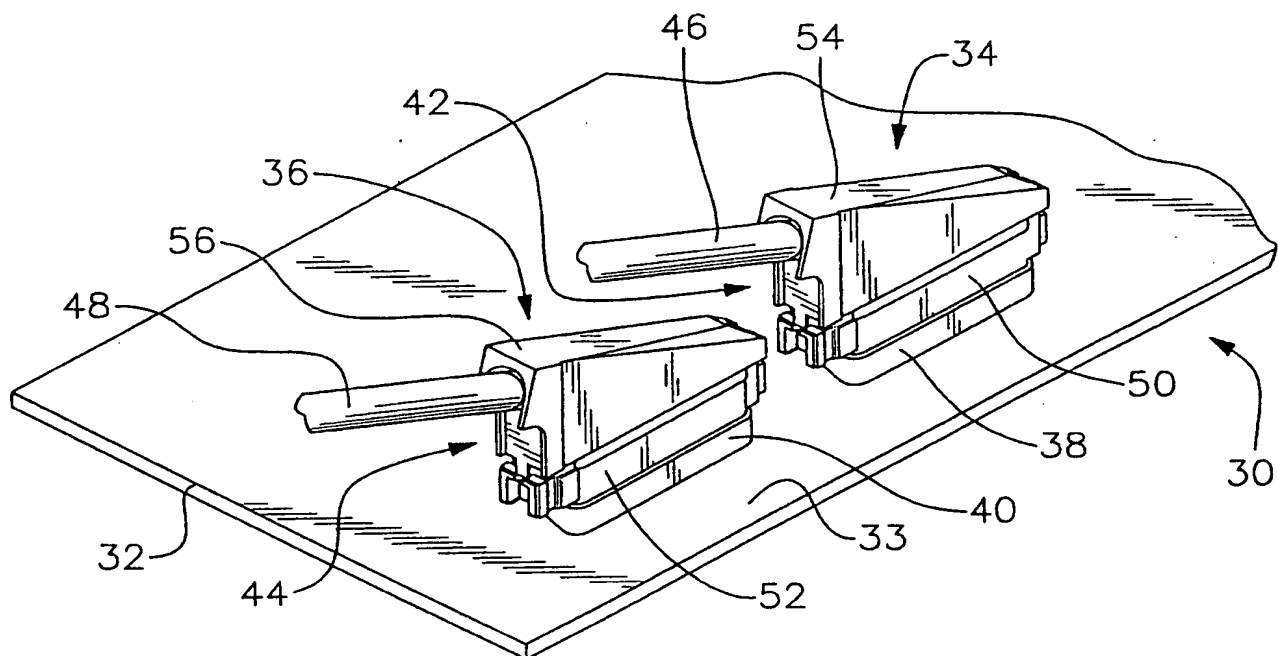
18. A connector as set forth in Claim 17, further including a support mechanism; said support  
10 mechanism attached to said connector and to said cable for holding said cable at said angle.

19. A connector as set forth in Claim 18, wherein said support mechanism provides strain relief for said cable.

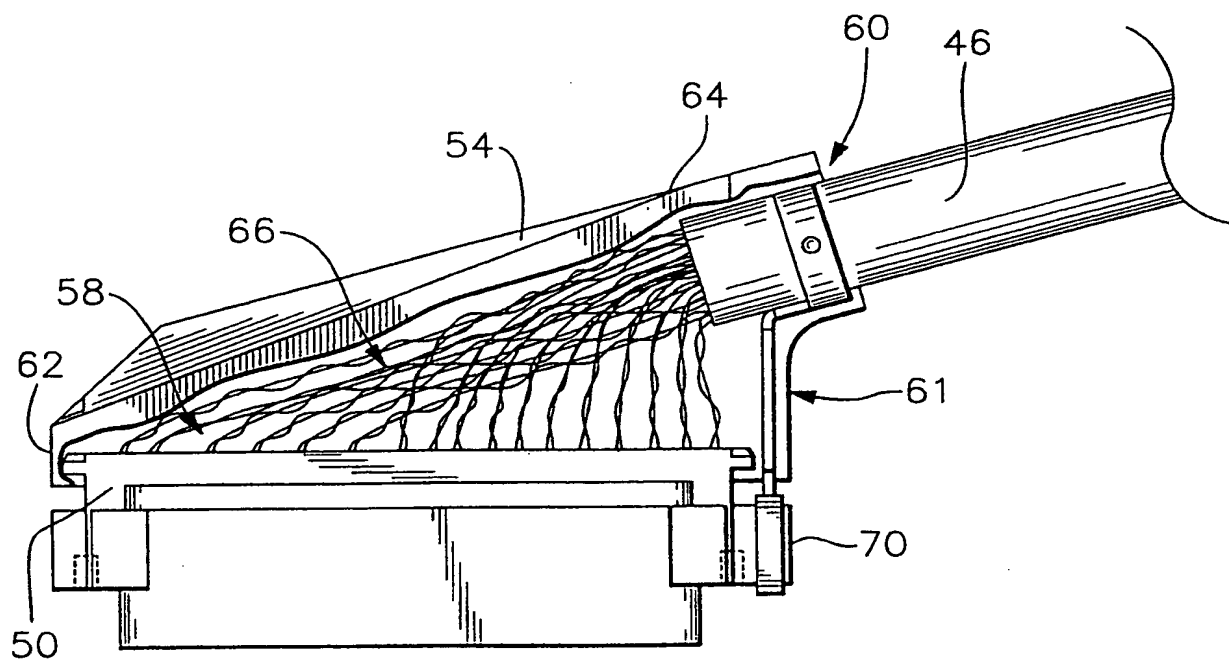
- 15 20. A connector as set forth in Claim 19, wherein said support mechanism includes first and second clamps and a plate located between said first and second clamps; said first clamp attached to said connector and said second clamp attached to said cable.

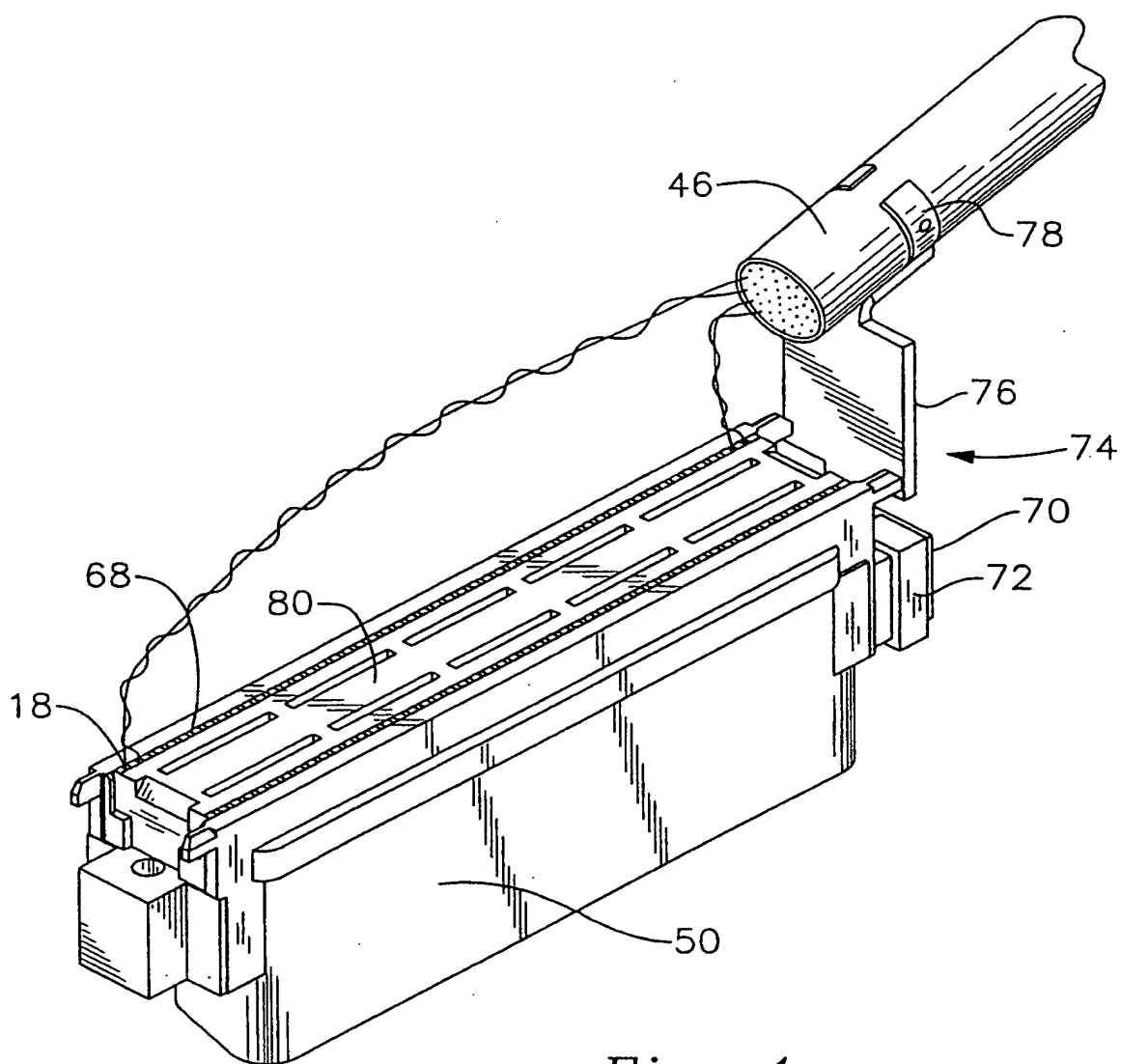


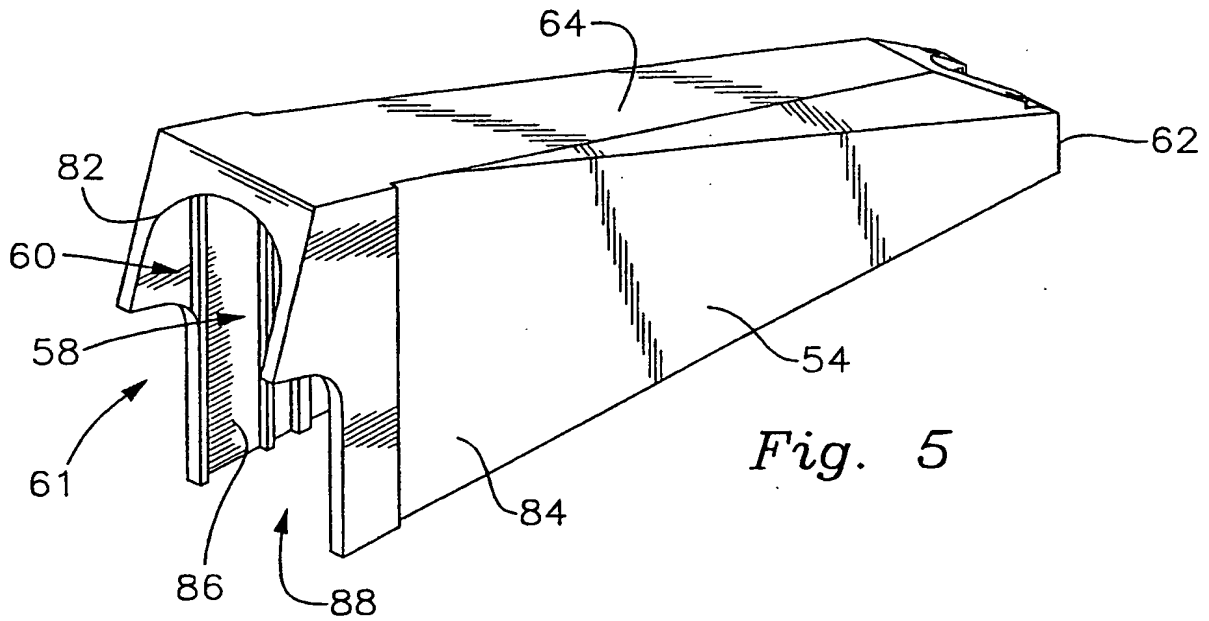
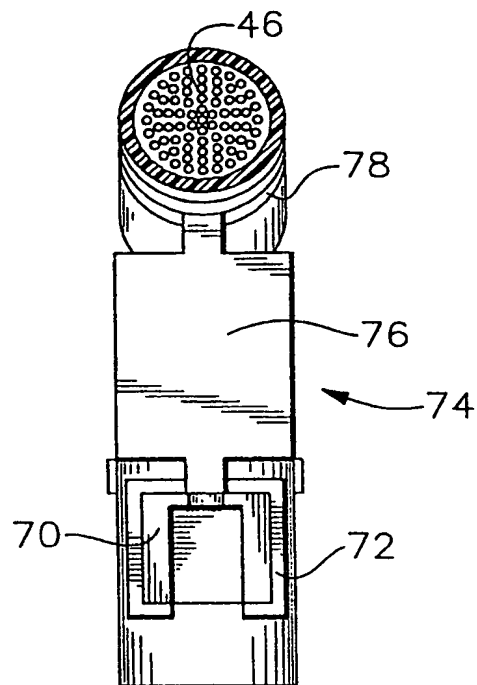
*Fig. 1*  
Prior Art

*Fig. 2*



*Fig. 3*

*Fig. 4*

*Fig. 5**Fig. 6*

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US98/24320

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) :HO1R 13/58

US CL :439/466

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 439/466, 468, 473

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
noneElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
none**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 4,842,547 A (DEFIBAUGH ET AL) 27 June 1989 (27/06/89), see entire document	1-3,6,7,15-17 ----- 4,5,8-14,18-20
Y ---- A	US 4,127,316 A (MCKEE ET AL) 28 November 1978 (28/11/78), see entire document	4,5,11,14,18,20 ----- 1-3, 6-10, 12, 13,15-17
Y ---- A	US 4,211,463 A (CHANDLER) 08 July 1980 (08/07/80), see entire document	4,5,11,14,18-20 ----- 1-3,6-10,12,13,15- 17



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

09 FEBRUARY 1999

Date of mailing of the international search report

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US98/24320

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y ---- A	US 4,422,705 A (KASPER) 27 December 1983 (27/12/83), see entire document	4,5,11,14,18-20 ---- 1-3,6-10,12,13,15-17
Y,P ---- A,P	BUCKALEW, Side Entry Connector, Western Electric tech. dis. bull., July 1979, No. 55.	4,5,11,14,18-20 ---- 1-3,6-10,12,13,15-17